Root maggots, principally the cabbage maggot, have increased in incidence and damage severity in canola in all three Prairie Provinces. Currently, estimates of average annual losses from root maggot damage range from $20 million to $75 million; in years of severe infestation, losses may reach $100 million. In canola, root maggots cannot be controlled with insecticides. The overall goal of this three-year project at the University of Manitoba from 2009 to 2011 was to obtain the data necessary to petition CFIA for introduction of *Aleochara bipustulata* for the biological control of root maggots in canola. The research results have provided most of the data required, and researchers expect to have the final data completed and the CFIA petition submitted in September 2012.

Root maggots (*Delia* spp.), principally the cabbage maggot (*Delia radicum*), first began to cause economic loss in canola in Alberta in the early 1980s, and since then maggots have increased in incidence and damage severity in all three Prairie Provinces. Currently, estimates of average annual losses from root maggot damage range from $20 million to $75 million; in years of severe infestation, losses may reach $100 million. In canola, root maggots cannot be controlled with insecticides and although cultural control can reduce damage somewhat, there is no single solution and additional methods of control are needed.

Researchers at the University of Manitoba have been working in collaboration with scientists from CABI–Europe Switzerland and Agriculture and Agri-Food Canada (AAFC) since 1999 on a program aimed at controlling root maggots in canola using a biological control agent introduced from Europe. The overall goal of this three-year project from 2009 to 2012 was to obtain the data necessary to petition the Canadian Food Inspection Agency (CFIA) for introduction of a small rove beetle *Aleochara bipustulata* for the biological control of root maggots in canola. Larvae of *A.*
*A. bipustulata* parasitize the pupal stage of cabbage maggots, and adult *A. bipustulata* are predators on maggot eggs.

To complete the CFIA petition package, researchers needed information not only on how effective *A. bipustulata* is at killing the target pest (the cabbage maggot), but also whether it might kill non-target insects, whether it might interfere with existing natural enemies of root maggots, and how it finds the habitats it lives in and the organisms it kills. Researchers already know that the range of insects that *A. bipustulata* can kill by parasitism is quite narrow.

In this three-year project, researchers conducted both laboratory and field studies to obtain the necessary data for the petition package. CFIA regulations allowed researchers to perform some laboratory studies of *A. bipustulata* at the University of Manitoba, in a containment facility. However, until the petition is granted, no field research on the insect can be conducted in Canada, and so all field research was performed in Switzerland.

The major findings from the laboratory and field research to March 2012, are that:

- the majority of non-target invertebrates in canola fields are not eaten by *A. bipustulata*, but that there may some risk of predation of carabid beetles (still being investigated).
- *A. bipustulata* does eat eggs and larvae of the target pest, both in the laboratory and the field, and that the number eaten is influenced by egg placement, and the density of eggs available.
- the introduction of *A. bipustulata* may not increase the number of root maggot eggs eaten, as there is evidence of competition between it and other predators that may limit total egg consumption by the guild of predators.
- *A. bipustulata* is an effective parasite of root maggot pupae, and its introduction will likely increase total levels of pest mortality due to parasitism, thus providing an important additional check on the population growth of root maggots.
- the chemical cues involved in host and prey finding by *A. bipustulata* are quite complex and include the simple organic molecule dimethyl disulphide (DMDS) and one or more volatiles given off by mustard seed meal.
- mustard seed meal mulch is an effective and specific method of attracting *A. bipustulata* to locations and can be used to increase predation and parasitism by *A. bipustulata*. The basis of this activity is not DMDS.
- DMDS affects both *A. bipustulata* and its Canadian relative *A. bilineata* in similar ways. The responses of these species are dependent upon age and stage of the insect, but are likely to result in parasitism of only those maggot pupae associated with canola and other brassicas and with a few other habitats. Additional

Figure 2. Aleochara larva attacking pupa. Source: Lars Andreassen.
constraints imposed by habitat preference and larval choice among hosts greatly restrict the risks to non-target species.

Researchers expect to complete the final components of the project, which is investigating the risk of predation of carabid beetles, by August 2012, followed by the preparation of the CFIA petition scheduled for submission in September 2012.

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